

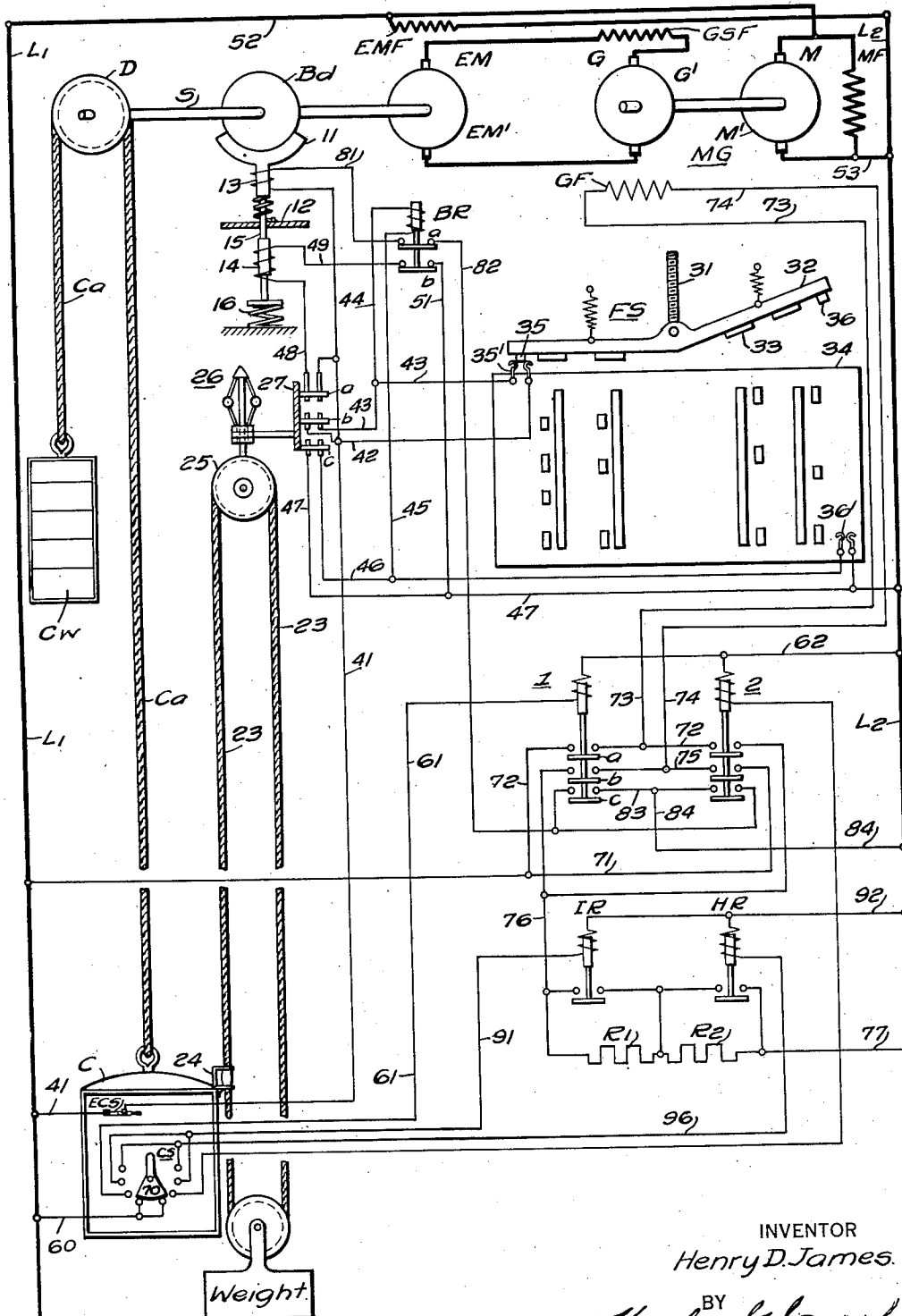
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H. D. JAMES

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ELEVATOR SAFETY BRAKING SYSTEM

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INVENTOR
Henry D. James.

BY
Wesley E. Carr
ATTORNEY

UNITED STATES PATENT OFFICE

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ELEVATOR SAFETY BRAKING SYSTEM

Henry D. James, Edgewood, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, a Corporation of Pennsylvania

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My invention relates to an elevator safety system, and, more specifically, to a system for checking the speed of an elevator car when it overspeeds or when a terminal is approached by a car without properly reducing the speed thereof to keep within the limits of the control system. As a terminal is approached by an elevator car, it is necessary to gradually reduce the speed thereof before it arrives at the terminal in order to avoid overrunning. This is especially true of high-speed elevator cars.

It is common practice to provide buffers at the terminals for the purpose of checking the speed of the elevator car and bringing it to a stop gradually. When the elevator car approaches the terminal at such a high rate of speed that it cannot be stopped at the floor, it will overrun and it is necessary for the buffer to absorb the entire kinetic energy of the rapidly moving car and its load within a comparatively short distance. Suitable buffers may require more space for installation than it is possible to provide unless the car speed is reduced by other means.

It is, accordingly, one object of my invention to provide means for automatically checking the speed of an elevator car when it approaches a terminal without its speed having been properly reduced by normal means.

Another object of my invention is to provide means for checking the speed of an elevator car when it overspeeds at any time, and which will automatically restore itself to normal running condition when the speed of the car has been sufficiently reduced.

It is also an object of my invention to provide for the application of the usual machine brake with varying degree of force, depending upon the requirements for safe operation.

According to my invention, I provide an auxiliary spring or springs on the machine or magnet brake, and an electromagnet which, when energized, tends to hold the auxiliary spring out of engagement with the brake shoe. The brake is normally operated in the usual manner, and, when its regular electromagnet is deenergized, the brake shoe is urged into engaging relation with the brake drum by the regular springs, thereby exerting a relatively light retarding torque in order to obtain smooth operation. The auxiliary spring actuating means does not affect the normal operation of the brake since its associated electromagnet is normally energized continuously and holds it in a disengaging position.

Such circuits are provided for controlling the energization of the two electromagnets that, in

normal operation, the regular electromagnet is controlled in the usual manner while the auxiliary electromagnet remains constantly energized. Upon the occurrence of abnormal conditions, however, the auxiliary electromagnet is deenergized to cause an application of the brakes, and, upon the occurrence of certain critical conditions, both electromagnets are deenergized to cause an emergency application of the brakes.

The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description, when read in conjunction with the accompanying drawing which is a diagrammatic view of an elevator and its control system with my invention applied thereto.

Referring to the drawing, the apparatus comprises an elevator car C suspended by a cable Ca which passes over the hoist drum D to the counterweight CW in the usual manner.

An elevator motor EM may drive the hoist drum D through a shaft S which carries the brake drum Bd of the usual "machine" or "magnetic" brake. A brake shoe 11 is normally urged into engaging relation with the brake drum Bd by a spring 12. An electromagnet winding 13 is associated with the brake shoe and, when energized, tends to move the shoe away from the brake drum in opposition to the spring 12, in the usual manner. The braking effort of the brake shoe, when applied by spring 12, is sufficient to stop and hold the elevator under normal conditions.

In order to provide additional braking effort for emergency conditions, I provide an auxiliary actuator 15 which is urged into engagement with the brake shoe 11 by an auxiliary spring 16. An auxiliary releasing electromagnet 14, when energized, holds the auxiliary actuator 15 away from the brake shoe 11 in opposition to the spring 16. Under normal operating conditions, the auxiliary electromagnet is continuously energized, the brake being applied or released by deenergizing or energizing the regular electromagnet 13.

When the auxiliary winding 14 is deenergized, the auxiliary actuator 15 will engage the brake shoe, and the force of the auxiliary spring 16 will be effective to apply the brake. When both windings are simultaneously deenergized, the force of both springs is effective in applying the brake.

The spring 16 may be of greater strength than the regular spring 12, whereby three degrees of braking force will be attainable by applying the

brake by the normal spring alone, the auxiliary spring alone or both springs together.

Under normal running conditions, both of the windings are energized, and the brake shoe 11 is held disengaged from the brake drum. When the car stops, the regular winding 13 will be de-energized, and the brake will be applied by spring 12 alone. Under emergency conditions, the auxiliary winding 14 will be deenergized or both may be deenergized, thereby setting the brake with greater force. The specific circuits for controlling these operations will be set forth in detail in connection with an assumed operation of the system.

The same results may be obtained by providing a second or auxiliary brake shoe to be moved into engagement with the brake drum Bd by spring 16 and moved to a disengaging position by electromagnet winding 14. Furthermore, an auxiliary brake drum may also be provided to be engaged by the auxiliary brake shoe, whereby two independent brakes are provided.

The elevator motor EM is provided with a field winding EMF which is separately excited from the main-line conductors L1 and L2. The armature EM' of the motor is energized by a generator G and is, for that purpose, normally connected in a loop circuit with the armature G' of the generator.

The field winding GF of the generator is separately excited from the main-line conductors L1 and L2 through a control system by which its energization may be reversed and its intensity varied in either direction. By varying the excitation of the generator in this manner, the voltage applied to the elevator-motor armature is likewise varied or reversed, and its speed or rotation correspondingly controlled in either direction.

The system for varying the excitation of the motor is known as a variable-voltage system of control and its operation will be set forth in greater detail later in connection with an assumed operation thereof.

The generator G is provided with a series field winding GSF which provides the desired degree of compounding. The armature G' of the generator is continuously driven by a motor M which is connected directly across the line conductors L1 and L2. Control apparatus for this motor is not shown because it would unnecessarily complicate the disclosure.

The governor rope 23 is releasably attached to the car, by means of any suitable yielding connection 24, and passes over a sheave 25 associated with a centrifugal governor 26, mounted at the top of the hatchway. When the elevator car moves, the governor rope moves with it and drives the centrifugal governor at speeds corresponding, or proportional, to the speed of the car in the hatchway.

The governor 26 may be of any well known construction and may, in fact, be the governor which is usually provided for tripping jaws (not shown) to grip the governor rope and set the car at safety (not shown).

Associated with the governor, is a contact carrying bracket 27 which will be raised or lowered in accordance with the speed of the governor. The bracket 27 carries bridging brushes a, b, and c which are moved in cooperating bridging relation to pairs of stationary contact segments. The stationary contact segments are so positioned that each pair is bridged by its corresponding brush at slow speeds and when the car is standing. As the speed increases, however, the brushes will be

lifted and the brushes b and c will be moved out of engagement with the corresponding stationary contact segments. The bridging brush "a" will remain in contact with its corresponding contact segments at all normal running speeds, but, if the speed increases to a certain predetermined degree of overspeed, it will be moved away from them and will interrupt the circuit connected therethrough.

The floor selector FS may be of a usual type comprising a movable arm 32 carrying bridging brushes 33 which are carried into engaging relation with various contact segments mounted on a stationary commutator 34. The arm 32 is moved across the face of the commutator by a threaded shaft 31 which is rotated in the one or the other direction in accordance with the movements of the car. Such floor selectors are commonly provided for the purpose of energizing various signaling circuits (not shown) in accordance with the movements of the car in the hatchway.

I provide wedges 35 and 36 of insulating material mounted on the arm 32 and cooperating pairs of spring contact members 35' and 36' mounted on the stationary commutator 34. As the arm 32 approaches the one or the other of its extreme positions one or another of the insulating wedges will be forced into operative engagement with its corresponding pair of spring contacts. Hence, the one or the other pair of contactors 35' and 36' will be forced apart to circuit-interrupting position when the car approaches either of its respective terminals.

The elevator car carries a car switch CS which is manipulated by the operator to control the operation of the car. An emergency car switch ECS is also carried by the car and may be opened by the operator to make an emergency stop.

My invention is more readily explained and understood, however, when considered in connection with an assumed operation thereof.

Assuming that the car is standing at a terminal, the various elements will occupy the positions shown in the drawing. The up and down relays 1 and 2 are deenergized, as are the intermediate-speed and high-speed relays IR and HR, respectively. The floor-selector arm 32 rests, at its upper positions, with the insulating wedge 35 separating the spring contact members 35'. The governor brush-supporting bracket rests at its lowest position, and its bridging brushes "a", "b" and "c" are all in operative engagement with their corresponding contact segments. The brake relay BR is energized to hold its contacting members "a" and "b" in circuit-closing position.

The circuit through which the winding of the brake relay BR is energized may be traced from the main-line conductor L1, by way of conductors 41 through brush "b" on the governor, to conductor 43, thence by way of conductor 44, through the winding of the relay BR, thence, by way of conductors 45 and 46, through the brush "c" on the governor and, by way of conductor 47, to the other main-line conductor L2.

The regular winding 13 of the brake is deenergized, because the contacts of the relays 1 and 2 are open, but the auxiliary winding 14 on the brake is energized. Hence, the brake is applied only by the force of spring 12 which is sufficient to hold the elevator under normal conditions.

The circuit by which the brake winding 14 is energized may be traced from the main-line con-

ductor L1, by way of conductor 41, to the brush "a" on the governor, thence, by way of conductor 48, through the winding 14, conductor 49, the contact members "b" of relay BR, thence, by way of conductors 51 and 47, to the line conductor L2.

The motor generator set MG is operative, because the motor M is connected across the line conductors from L1, through conductor 52, the armature M' and field windings MF of the motor M, and, by way of conductor 53, to main-line conductor L2. The generator G, however, is ineffective since its field winding GF is not energized.

When the operator desires to start the car, the car switch CS may be rotated in the one or the other direction, depending upon the direction the car is to be moved. Assuming that the operator moves the switch in a clockwise direction, the winding of the up-direction relay 1 will be energized and effect the closure of the contacts associated therewith.

The circuit by which the winding of relay 1 is energized may be traced from line conductor L1, through conductor 60, the conducting segment 70 of the car switch, conductor 61, the winding of relay 1, and, by way of conductor 62, to line conductor L2.

The actuation of the contacting members of the relay 1 to circuit-closing position will complete circuits for energizing the field winding GF of the generator and the brake winding 13. This will cause the actuation of the elevator motor EM and the simultaneous releasing of the brake. It will be seen, by tracing the energizing circuit of the generator field winding GF, that the resistors R1 and R2 are included therein. This will result in a low degree of excitation of the field of the generator, whereby a low potential is applied to the armature of the elevator motor, and the elevator is operated at slow speed.

The circuit established for energizing the generator field winding GF may be traced from line conductor L1, through conductors 71 and 72, contact members "a" of relay 1 thence, by way of conductor 73, through the field winding GF, conductors 74 and 75, contact members b of relay 1, through conductor 76, resistors R1, R2 and conductor 77, to line conductor L2.

The completed circuit for energizing the brake winding 13 may be traced from line conductor L1, by way of conductor 41, through the brake winding 13, thence, by way of conductor 81, contact members "a" of brake relay BR, conductor 82, contact members c of relay 1 and conductors 83 and 84, to the other main-line conductor L2.

In order to drive the elevator at a higher rate of speed, the operator will rotate the car switch to its next position in the clockwise direction, thereby energizing the intermediate-speed relay IR. This relay will pull up its armature to cause its contacting means to close, thereby establishing a shunt circuit around the resistor R1 and increasing the excitation of the generator field winding GF. A higher voltage will consequently be applied to the armature of the elevator motor to drive it at a higher rate of speed.

The completed circuit for energizing the winding of relay IR may be traced from line conductor L1, through conductor 60, from the conducting segment 70 of the car switch to conductor 91, through the winding of relay IR, thence, by way of conductor 92, to the other line conductor L2.

For high-speed operation of the elevator, the operator moves his car switch to the extreme position in the clockwise direction, thereby energizing

high-speed relay HR. The relay HR, in pulling up its armature, moves its contact members to a circuit-closing position, thereby shunting the resistor R2 out of the energizing circuit of the generator field winding GF, and still further increasing the potential applied to the elevator motor.

The circuit for energizing the winding of the relay HR is completed from the line conductor L1, by way of conductor 60, conducting segment 70 of the car switch, conductor 96, through the winding of the relay HR, thence, by way of conductor 92, to the other line conductor L2.

As the elevator car continues in motion upward, it drives the governor rope 23, the governor sheave 25 and the associated governor 26 at speeds corresponding to the speed of the car. As the speed of the car increases, the governor lifts the bracket 27 and, at some predetermined speed, (half normal speed, for example) the brushes "b" and "c" will be moved out of engaging relation with their cooperating stationary contact segments. It will be noted, however, that the opening of these contacts will not be effective to interrupt the circuit, since the pairs of spring contacts 35' and 36' are connected in parallel with the governor contact means "b" and "c", respectively.

The floor selector arm 32 is moved across the commutator 34 in accordance with the motion of the car in the hatchway. Consequently, as soon as the car moves away from the terminal, the insulating wedge 35, carried by the arm 32 of the floor selector, will be disengaged from the spring contacts 35' which will then assume contacting relation. This will occur before the car has time to attain any appreciable degree of speed, and, by the time the car has attained sufficient speed (half normal speed, for example) to move its brushes "b" and "c" away from their stationary contact segments, the circuit will be completed through the parallel spring contactors 35' or 36'.

Assuming now that the elevator car attains an undesirable degree of overspeed, the governor-actuated brush "a" will be lifted away from its cooperating stationary contact segments, and the energizing circuit for the emergency winding 14 will be interrupted. This circuit, which was previously traced, extends through the brush "a" of the governor. The deenergization of the electromagnet winding 14 will release the spring-pressed actuating member 15 which will be forced into engagement with the brake shoe 11 by the spring 16, thereby setting the brake and checking the speed of the car.

The reduction of the speed to normal will permit the winding 14 to be reenergized and release the brake, and normal operation may be resumed. Before the car arrives at the terminal, the arm 32 of the floor-selector will carry the insulating wedge 36 between the spring contacts 36'. The spring contacts 36' are so positioned that this will occur when the car arrives within the zone where slow-down must have been initiated, and the speed reduced (for example, to about half normal speed) in order to bring the car to a stop at the terminal.

The stationary governor contact segments which are engageable by brushes b and c of the governor are so positioned that the brushes will be lowered into engaging relation therewith when the speed of the car has been reduced sufficiently to have it under control at the position where the floor selector contact members 36' will be separated.

The pair of stationary contact segments engaged by the governor brush "c" are connected in parallel with the contact members 36' of the floor

selector and, as previously traced, the energizing circuit of the relay BR extends from the conductor 45, through these contact members in parallel, to conductors 47 and L2. Hence, the relay BR will not be deenergized while either contacting means is closed, and, in the normal operation of the elevator car, the governor-actuated contacting means will be closed before the floor-selector-actuated contacting means is opened.

If the speed of the elevator is not sufficiently reduced to have it under control as the terminal is approached, the floor-selector contacting means 36' will be opened, before the governor-actuated contacting means is closed, and the winding of the brake relay BR will be deenergized.

The relay BR will now drop its armature, thereby interrupting the circuits of both brake windings 13 and 14 at its contact members "a" and "b", respectively.

The brake will, consequently, be applied with emergency force by both springs 12 and 16. The braking force applied may be made sufficient to stop the car by the time it arrives at the terminal, or it may only check the speed of the car enough to ease the action of the buffer. Furthermore, the brake may also be set with emergency force at any time by manually opening the car emergency switch CES.

Since the actuation of the system in the reverse direction is similar to that above set forth, further description is not deemed necessary. The operation of my invention has been considered under various conditions and I have shown the machine brake, which is usually applied gently for stopping and holding the car in the normal operation thereof, may, in accordance with my invention, be applied automatically with greater force to check the speed of the car when it is overspeeding. It has also been demonstrated that the brake will be applied automatically with emergency force when the car approaches a terminal without sufficiently reducing its speed.

After each actuation of my device, its restoration for normal running conditions is automatically effected as soon as the speed of the car has been sufficiently reduced.

I do not wish to be restricted to the specific structural details, arrangement of parts or circuit connections or to the specific speeds or braking forces set forth, as various modifications thereof may be effected without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. The combination with an elevator system comprising an elevator car, a control system therefor, and a braking device comprising a brake drum, a brake shoe, a spring normally urging said brake shoe into engagement with the brake drum to apply a braking effort thereto, and electromagnetic releasing means associated therewith to hold the shoe disengaged from the drum when energized, of an auxiliary actuating mem-

ber mounted adjacent to said brake shoe for movement into engagement therewith, an auxiliary spring for urging said actuating member into engagement with said brake shoe, auxiliary electromagnetic releasing means associated with said actuating member for holding it away from the brake shoe in opposition to said auxiliary spring, means associated with the control system to deenergize said first electromagnetic releasing means when the control system is effected to stop the car, and additional means to deenergize both electromagnetic releasing means to apply the brake with emergency force when the car approaches a terminal at undiminished speed.

2. The combination with an elevator system comprising an elevator car, a control system therefor and a braking device comprising a brake drum, a brake shoe, a spring normally urging said brake shoe into engagement with the brake drum to apply a braking effort thereto, and electromagnetic releasing means associated therewith to hold the shoe disengaged from the drum when energized, of an auxiliary actuating member mounted adjacent to said brake shoe for movement into engagement therewith, an auxiliary spring for urging said actuating member into engagement with said brake shoe, auxiliary electromagnetic releasing means associated with said actuating member for holding it away from the brake shoe in opposition to said auxiliary spring, means associated with the control system to deenergize said first electromagnetic releasing means when the control system is influenced to stop the car, and additional means manually actuatable by the operator to deenergize both electromagnetic releasing means to apply the brake with emergency force at any time.

3. The combination with an elevator system comprising an elevator car, a control system therefor and a braking device comprising a brake drum, a brake shoe, a spring normally urging said brake shoe into engagement with the brake drum to apply a braking effort thereto, and electromagnetic releasing means associated therewith to hold the shoe disengaged from the drum when energized, of an auxiliary actuating member adjacent to said brake shoe for movement into engagement therewith, an auxiliary spring of greater strength than said first spring for urging said actuating member into engagement with said brake shoe, auxiliary electromagnetic releasing means associated with said actuating member for holding it away from the brake shoe in opposition to the spring, means associated with the control system to deenergize said first electromagnetic releasing means when the control system is effected to stop the car, means to deenergize both electromagnetic releasing means to apply the brake with emergency force when the car approaches a terminal at undiminished speed, and additional means to deenergize the auxiliary electromagnetic releasing means when the car overspeeds.

HENRY D. JAMES.